Comparative Evaluation of Lumbopelvic and Dynamic Neuromuscular Stabilization Exercises on Chronic Lumbopelvic Pain and Asymmetry in Obese Post-Menopausal Women

SHORT SYNOPSIS

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ABSTRACT

Chronic lumbopelvic pain (CLPP) is gradually becoming a health concern among postmenopausal women. CLPP affects 45-75% of menopausal women, impacting their daily chores and quality of life (Wáng et al., 2016). During menopause, pain sensitivity increases, accompanied by weight gain, which causes additional pressure on the spine and pelvis biomechanically, leading to CLPP (Dugan et al., 2018). Physiotherapeutic interventions so far are effective for short-term relief of symptoms for CLPP, creating a need to explore alternative interventions (Lee et al., 2019). Studies have found that Dynamic Neuromuscular Stabilization (DNS) and Lumbopelvic Stabilization exercises can alleviate the symptoms of CLPP. Despite the literary evidence, there is limited research that can compare the effectiveness of these interventions for CLPP in postmenopausal women. This study aims to compare the efficacy of DNS versus Lumbopelvic stabilization exercise interventions in managing chronic lumbopelvic pain among postmenopausal women, addressing the present gap in current literature and potentially offering evidence-based treatment alternatives for this less-studied population.

OBJECTIVE- The aim is to assess the effectiveness of DNS versus the Lumbopelvic Stabilization exercise protocol on the chronic lumbopelvic pain of obese post-menopausal women.

METHOD— A sample of 72 postmenopausal obese women who meet the eligibility requirements will participate in a pre-posttest experimental investigation. A randomly selected sample population will be divided into 3 groups: two experimental groups and a control group. One of the experimental group interventions will be DNS, another will be the Lumbopelvic Stabilization exercise for CLPP, and the last group will be given general lifestyle modification recommendations. The intervention is provided for 20 minutes, 3 days per week, for the duration of eight weeks.

RESULTS- Data analysis will be done for the pretest and posttest values of the outcome measures with proper statistical measures. The result will indicate the role of DNS versus Lumbopelvic stabilization exercise in alleviating CLPP in obese postmenopausal women.

Keywords- DNS, Lumbopelvic Stabilization exercise, Menopause, Obesity

Abbreviations:

DNS- Dynamic Neuromuscular Stabilizer

CLPP- Chronic lumbopelvic pain

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Certificate

I hereby declare that the thesis titled **"Comparative Evaluation of Lumbopelvic and Dynamic Neuromuscular Stabilization Exercises on Chronic Lumbopelvic Pain and Asymmetry in Obese Post-Menopausal Women"** being submitted in fulfillment of the requirementfor the degree of Doctor of Philosophy in the Department of Physiotherapy under School of Allies health Sciences of Manav Rachna International Institute of Research & Studies, Faridabad during the academic year 24-25.It is a bona fide record of original work carried out under the supervision of Dr.Jasmine Kaur Chawla and has not been submitted in full or part to any other university or institute for a degree or diploma. Further, it is certified that the Thesis is plagiarism-free and proof has been submitted.

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INTRODUCTION

1.1 **Postmenopause**

Women endure adventures in all spheres of their lives. Even health is a rollercoaster ride, which is triggered by various hormones that play their part in different stages of life. A very crucial and yet delicate stage is menopause, the final stage of reproductive health that usually begins in a woman's 40s. Being multifactorial, it can start early. Menopause health may be affected by various reasons, such as socioeconomic, geographical, or financial aspects, and its duration varies as well, for about 8 to 10 years. According to an IMS PAN India survey, Indian women reach menopause at an average age of 44.69 ± 3.79 years. The fluctuating estrogen hormone level plays a central role in menopause as it significantly affects bone density, joint health, and inflammatory pathways, ultimately causing musculoskeletal pain. A study has found that estrogen acts on the inflammatory processes and pain pathways, and the decrease in estrogen levels during the menopause phase increases pain sensitivity and chronic inflammation [Torgrimson & Minson, 2020]. This eventually makes women prone to chronic lumbopelvic pain (CLPP). [(Hoy, D.et al.,2012), (Bergström C., et al., 2017), (Sushil P et al.,2023)].

1.2 **Chronic lumbopelvic pain (CLPP) – Definition, prevalence, and its impact**

Chronic lumbopelvic pain (CLPP) is the pain that persists in the lower back and pelvis region over a long period. It can be a sharp pain, a dull ache, or pain that radiates into the buttocks, hips, or thighs. Radiating pain can also cause numbness and weakness in the legs. Several issues, including pregnancy, herniated discs, and muscle weakness, can cause it, but its prevalence is quite high in menopausal women. About 45-75% of menopausal women experience chronic lumbopelvic pain (CLPP), which significantly impairs their quality of life and everyday activities. It impacts a woman’s productivity and workability, causing disability [Wang et al., 2016]. A study found that among employed women with CLPP, 15% experienced a loss in time from paid work, and 45% had reduced productive work [Mathias SD. et al.,1996]. CLPP is not just a physical hazard but a dent in the pocket for women. It has been found that women are frequent visitors f rehabilitation for CLPP [Hoy, D.et al.,2012]. Even the World Health Organization (WHO) acknowledges the necessity of spine care in everyday activities

for women to be more ergonomically sound and raise awareness. [Wang et al., 2016]. Hence, there is a need to take care of CLPP as a global health hazard.

1.3 **CLPP and Obesity/ Overweight**

Studies have shown that CLPP is quite prevalent among obese menopausal women in India and is attributed to hormonal, biomechanical, and lifestyle factors [Sharma et al., 2019]. Obesity can be associated with a lifestyle disorder, but in the case of women, it has greater multidimensional root causes, which are often related to their hormonal fluctuations. The hormonal interplay can lead a woman to gain excessive weight, such as in the condition of menopause. Menopause-related weight gain ultimately increases mechanical stress on the lumbopelvic structures; this overburden eventually leads to the development of CLPP [Cagnacci et al., 2019]. Obesity causes a burden on the musculoskeletal system of women by exerting excessive mechanical load on the lumbar spine and pelvic girdle, leading to structural stress and eventually chronic lumbopelvic pain [Verma & Agarwal, 2020]. The sociocultural norms and limited awareness about the benefits of physical activity to control obesity in the menopause stage of women are often attributed to sedentary behaviors, which further exacerbate the risk of CLPP [Kaur et al., 2021]. Psychological factors such as anxiety and depression are often associated with the post-menopause stage. These factors amplify pain perception; due to the multifaceted interplay between hormonal, biomechanical, and psychosocial factors in the development of CLPP.

1.4 **CLPP Treatment-**

CLPP has a dynamic nature and is caused by various underlying causes. Pharmacological treatment options provide temporary symptomatic relief but do not provide permanent management of CLPP. Research proves that to address the dynamic nature of CLPP, a multidisciplinary approach is required that can incorporate self-management strategies and psychological support. [Blanco-Giménez, P. et al., 2024]

Research studies on conventional physiotherapy treatments are suggestive of their efficacy against CLPP. They include strategies of pain management, functional improvement, and general quality of life interventions. A review study suggests physiotherapy pain management strategies such as electrotherapeutic modalities, ultrasound (US), transcutaneous electrical

nerve stimulation (TENS), pelvic floor muscle training, manual therapy, which includes joint and myofascial release, changing one's lifestyle to include ergonomic advice, activity pacing, and stress management for the management of CLPP [Petersen, K., et al., 2016].

Even exercise therapy interventions such as progressive strength training and core stabilization exercises can be successful in reducing CLPP and improving function [Smith et al., 2020]. Further research has been conducted on manual therapy methods, such as soft tissue manipulation and spinal mobilization, frequently combined with exercise therapy to alleviate pain and increase mobility [Koes et al., 2019]. Also, many researchers are using integrative approaches along with physiotherapy techniques to find a long-term management strategy for CLPP. A recent study combined physiotherapy with cognitive-behavioral therapy (CBT) and found it effective in addressing the psychosocial aspects of CLPP, particularly for patients with fear-avoidant behaviors [Linton & Nordin, 2021]. Along with it, emerging interventions such as motor control exercises and neuromuscular re-education are also proving to be effective in managing CLPP by enhancing muscle coordination and reducing dysfunction [O'Sullivan et al., 2018].

Despite the presence of so many intervention strategies, there is still a need for an intervention strategy that can address the unique demands of weight management and physical activity, along with psychosocial factors concerning the socio-cultural context of Indian menopausal women, to alleviate the CLPP.

1.5 **Dynamic Neuromuscular Stabilization (DNS)**

Dr. Pavel Kolar has discovered the rehabilitation approach of Dynamic neuromuscular stabilization (DNS). It lays its emphasis on the restoration of optimal movement patterns by focusing on the neuromuscular control mechanisms that are established during early human development. The objective of DNS is to improve function by retraining the body's stabilization system, particularly the integrated spinal stabilizing system, which includes the diaphragm, pelvic floor, abdominals, and spinal extensors. DNS retrains the neuromuscular system to restore the ideal movement patterns, which focus on core stability, postural alignment, and breathing mechanics. These interventions can address the biomechanical strains associated with obesity induced burden on the musculoskeletal system, which impairs motor control and exacerbates the lumbopelvic dysfunction [Kolar et al., 2019].

DNS is an upcoming therapeutic remedy that can combat the effects of CLPP. A lot of research is being conducted to explore the domain of DNS. A study published in the Journal of Sports Rehabilitation indicated the benefits of DNS in sports rehabilitation to enhance athletic performance by optimizing core stability and movement efficiency [Frank. C et al.,2013]. Another study indicates the impact of an eight-week DNS exercise program on low back pain. As a result, notable changes in functional movement patterns, balance, and pain levels were found, indicating that DNS may be a beneficial intervention for treating long-term musculoskeletal disorders like CLPP [Rabieezadeh et al., 2024]. DNS is showing promising outcomes in terms of strengthening musculoskeletal function, improving core stability, and supporting the recovery from a number of illnesses, including CLPP [Sharma K. et al.,2023]. In populations with altered biomechanics, such as postmenopausal women with increased abdominal obesity, DNS has resulted in trunk stabilization and reduced discomfort [Frank et al., 2020].

1.6 **Lumbopelvic Stabilization Exercises -**

The purpose of Lumbopelvic stabilization exercises is to maintain the lumbar spine stable. Various names are given to these exercise techniques, including segmental stabilization exercises, core stabilization, and lumbar stabilization. At present, there isn't a formal definition of lumbopelvic stabilization exercises. The function of these exercises is to increase the strength, endurance, and neural and muscular control of the muscles that are essential for dynamic spinal and truncal stability. They target a number of muscle groups, including the lumbar multifidus and transversus abdominis (TrA), as well as other paraspinal, abdominal, diaphragmatic, and pelvic musculature [Standaert C.J.et al.,2008].

In order to maintain the neutral lumbar during daily chores and occupational tasks, the core stability exercises primarily focus on training particular deep and local stabilizing muscles of the spine. [Miller ER et al., 2005]. The neural control unit, which measures and evaluates the stability and coordination adjustments for the muscle response, accomplishes the work. The spinal or core stabilization system is made up of the spinal column, whose structure offers intrinsic stability, and the muscles, which provide dynamic stability [Ghosh S et al., 2014]. The core muscles serve as the central stabilizing muscles and are categorized by their function into global muscles, including the rectus abdominis, spinal erectors, and the external oblique, along

with local muscles, which are inclusive of transversus abdominis and lumbar multifidus. The global muscles play a role in trunk movements, whereas local muscles are crucial for stabilizing the core. Among these, the transversus abdominis and lumbar multifidus considerably contribute to the spinal functional activities. [Zheng Y, Ke S, Lin C, et al.,2019].

Additionally, the core stabilization exercises are intended to target the central muscles, which include the pelvic muscles, transversus abdominis, lumbar multifidus, paraspinal, abdominal, and diaphragmatic muscles. By lowering joint tension, developing muscle, boosting resistance, and adjusting posture, they improve spinal stability and lessen the risk of lumbopelvic injuries. [(Pourahmadi MR, Taghipour M, Takamjani, IE, et al.,2016), (Akhtar MW, Karimi H, Gilani AS, et al.,2017) (Hoppes CW, Sperier AD, Hopkins CF, et al.,2016)]

Through various research studies, it has been found that both DNS and LPSE are providing a promising alternative treatment for CLPP. Looking at their prognosis reports from various studies, we assume these strategies can be applied for the long-term benefit of CLPP in obese menopausal women.

Till now, there has been no comparative study done that compares these two techniques of DNS versus Lumbopelvic Stabilization exercises to identify their therapeutic effects on chronic lumbopelvic pain in post-menopausal women. Although both techniques have the potential to fulfill the demand of alleviating CLPP in obese menopausal women, there is a significant gap in research on the comparative analysis of these techniques on obese postmenopausal women of India.

LITERATURE REVIEW

2. Review of Literature –

2.1- **Chronic Lumbopelvic pain in women-**

[Sushil P, Chawla J.K, Parashar R.K, 2023] To investigate the relationship between chronic LPP with conditions like stress, various exercises, and socioeconomic status, a cross-sectional investigation involving 500 women of various socioeconomic sections in an urban area of India was carried out. The study included a sample of women between the ages of 18 and 62. They discovered that 76.8% of Indian women had LPP, with 70.5% coming from lower socioeconomic groups and 29.4% from higher socioeconomic groups. Also, they found a connection between LPP and gynecological disorders like PCOD (polycystic ovarian syndrome) as well as other health problems such as chronic cough, lack of exercise, psychological stress, and urinary incontinence.

[Chawla J.K et al., 2024] The free health camps were conducted through which the author did a cross-sectional study on 2400 women in Delhi, India, to develop an assessment criterion that can predict the risk factors of CLPP in Indian women. As a result they found on an average, 70.4% Indian women suffer from CLPP, and seven risk factors are linked to it which are as follows such as tightness in the hamstring muscles, increased lumbar lordosis, decreased hip flexibility, altered foot posture, elevated psychological stress, a decreased level of physical activity, and finally, a decreased transversus abdominis muscle performance. They have been considered as strong predictors of risk factors for developing CLPP, according to the authors.

[Moheboleslam Z et al., 2022] Randomized Controlled Trials (RCTs) consisting of stabilization exercises for lumbopelvic pain were reviewed and meta-analyzed by the author. In order to investigate the impact of stabilizing exercises on postpartum women's pain intensity, disability, as well as quality of life (QoL), the author incorporated 11 RCT studies consisting of 623 participants. Inclusion criteria had English-language RCTs with women more than 18 years of age, a control group, and a pre-post design. The examination included LBPP intensity, quality of life, and disability. There was an initial investigation to determine how lumbo-pelvic stabilization exercises affect postpartum women with LBPP in terms of pain, disability, and quality of life. The results obtained showed that while stabilization exercise interventions

significantly reduced disability and pain intensity, but had little effect on quality of life. So, according to this review study, postpartum women benefited from stabilizing measures. However, further high-caliber research is needed to show the effectiveness of stabilizing activities in reducing LBPP.

2.2: **CLPP AND Obesity/Overweight**

Many researchers, such as [Nandi N, Bhadra B., 2015; Ahdhi G. et al., 2016; Gupta G, Nandini N, 2015; Mitra K et al., 2017; Shameela TV et al., 2015; Koley S, Sandhu NK, 2009; Shah SK et al.,2016; Shivaji KK et al.,2019], have found that pain and disability are associated with CLPP. Also, studies have concluded that certain risk factors are associated with CLPP, such as age, i.e., later in the woman's age, and increased BMI, leading to Obesity [Mitra K et al., 2017; Shameela TV et al., 2015; Varte LR et al., 2012].

[Arora P and Dey S, 2024] The impact of obesity on pelvic kinematics and spinal biomechanics as a reason for chronic low back pain was investigated by Prateek Arora and Samarjit Dey in 2024. According to their article, obesity causes changes in the kinematics of the pelvis and the biomechanics of the spine, which leads to chronic low back pain (CLBP). They discovered that the inflammatory state, high mechanical strain, and muscular imbalances brought on by obesity or heavy weight on the musculoskeletal system promote degenerative changes in the spine and pelvis, which exacerbate discomfort and decrease your quality of life. Similar findings have been drawn by many more researchers. .[Buckland AJ et al., 2020; Ghasemi M, Arjmand N., 2021; Haffer H et al., 2021; Bayartai ME et al., 2023; Singh NK et al., 2024].

[Okifuji A and Hare B D, 2015] In 2015, Bradford D. Hare and Akiko Okifuji wrote a review paper about the co-occurrence of obesity and chronic pain. Both obesity and chronic pain are public health concerns; the author attempted to determine how they relate to one another. According to [Higgins DM et al. (2014)], both are frequently found together and have an impact on one another. However, several factors influence their relationship, including lifestyle choices, inflammatory mediators, mood swings, and sleep problems, as well as biomechanical or structural changes linked to obesity [DeVon HA et al., 2014; Arranz LI et al., 2014].

Numerous research studies, whether conducted on young people [Deere KC et al., 2012; Hoftun GB et al., 2012; Smith SM et al., 2014] or older people [McCarthy LH et al., 2009], support the notion that obesity and pain perception are related. (S. Ferguson and others, 2013) Additionally, one may cause the other. For example, functional limitation from chronic pain may result in weight gain, which may be caused by overeating, a sedentary lifestyle, poor sleep, or even medication side effects [Janke AE et al., 2012; Smith HS et al., 2012; Tzellos TG et al., 2010; Knutson KL et al., 2008]. According to other research with comparable characteristics, the prevalence of CLPP rises with BMI [Smith SM et al., 2014; Hitt HC et al., 2007; Smuck M et al., 2014].

Obesity has also been linked to the diagnosis of pain, including fibromyalgia, headaches, low back pain, even chronic generalized pain, and abdominal pain, according to other studies [Wright LJ et al., 2010]. Furthermore, obesity may increase the likelihood of developing pelvic, abdominal, and even neuropathic pain [Gurian MB et al., 2015; Chai NC et al., 2014]. People suffering from chronic pain can generally be linked to significant physical handicap and psychological suffering [Marcus DA et al., 2004]. Prior research comparing obese and non-obese patients demonstrated that obese LBP patients seemed to have more comorbid issues and to be more functionally impaired [Fanuele JC et al., 2002]. In conclusion, discomfort and related quality of life may benefit from weight loss.

2.3- **CLPP and menopause** -

Research has found that CLPP and menopause are interrelated. Many factors, such as hormonal, biomechanical, and psychosocial factors, influence their relationship. The menopause stage in a woman's life is marked by a significant decline in estrogen levels, which affects various musculoskeletal and pain-regulation mechanisms.

Accordingly, the estrogen hormone is essential for preserving bone density, joint health, and neuromuscular function [Sharma et al., 2019]. Menopause results in the estrogen levels dropping, and it has also been linked to osteoporosis, weakened muscles, and joint degradation, all of which can increase the risk of developing CLPP. Also, estrogen shortage increases

inflammatory processes and lowers the pain threshold, further aggravating chronic pain syndromes as CLPP [Torgrimson B.N. & Minson C.T., 2020].

The research study done by [Cagnacci et al.2019] has findings that the hormonal and metabolic changes occurring in menopausal women make them prone to gain weight, which eventually leads to obesity. This excess weight causes imbalance and increases mechanical loading on the lumbar spine and pelvic girdle, leading to postural imbalances and joint overload, which are the primary contributors to lumbopelvic dysfunction.

Another study done by [Linton S.J. & Shaw W.S. (2020)] concluded that the psychosocial factors, such as anxiety, depression, and stress, are commonly associated with the menopausal transition. Together, they can amplify pain perception and negatively impact coping mechanisms, thus creating a multifactorial interplay, which results in the persistence of CLPP.

2.4 – **Evidence-based physiotherapy treatment for CLPP-**

To manage CLPP, a comprehensive and multidisciplinary approach is required. Various aspects of pain management, such as Pharmacological interventions, lifestyle and ergonomic modifications, Pain management modalities, i.e., heat and cold, and electrotherapy, such as TENS and US, are required. However, many evidence-based physiotherapy interventions have proved beneficial for long-term benefits.

[Smith et al., 2020] emphasized exercise therapy as a treatment option. According to the author, exercise forms the basis of treatment, with core stabilization exercise being particularly effective. In order to increase spinal stability and lessen the mechanical pressure on the lumbopelvic region, the authors discovered that these workouts can activate deep stabilizing muscles such as the multifidus and transverse abdominis (Tr.A).

O'Sullivan et al. (2018) have found in their study that motor control exercises, which focus on retraining movement patterns and improving neuromuscular coordination, can show significant benefits in alleviating pain and enhancing function in CLPP patients.

Further, studies have explored the integrative approach for better treatment plans, such as one of the studies by [Koes et al.,2019] supported integrative methods for managing pain. The authors discovered that in order to reduce discomfort and increase mobility, manual therapy

techniques—such as soft tissue techniques and spine mobilization—can often be used with exercise treatment. Another study confirming the role of the integrative approach of multiple disciplines as a better treatment strategy involves the integration of combining cognitive-behavioral therapy (CBT) with Physiotherapy. According to the author, it can address the psychosocial factors contributing to CLPP [Linton & Nordin, 2021].

Still, due to the requirement for an effective treatment option to combat CLPP, many studies are being conducted on new techniques. Many emerging methods are showing promising results in controlling CLPP. One of the promising techniques introduced by [Kolar et al. 2019] is Dynamic Neuromuscular Stabilization (DNS), which shows a good prognosis for treating CLPP. Another approach that is showing promising results is Lumbopelvic Stabilization exercises. Another study done by [Tekur et al. 2018] found mind-body interventions such as Yoga to be effective for the management of CLPP. As per the systematic review by [Ying Li et al. (2023)], several techniques, such as tai chi, yoga, Pilates, sling exercises, motor control exercises, and core or stabilization exercises, have a good prognosis for treating CLBP when compared to conventional rehabilitation and without intervention. Nonetheless, core and stabilization activities are statistically significant in enhancing physical function when compared to traditional therapy and no intervention.

2.5- **Dynamic neuromuscular stabilization and CLPP**-

DNS is an emerging treatment strategy for CLPP. The concept of DNS was given by Pavel Kolar and is based on developmental kinesiology.

[Sharma K. and Yadav A., 2019] explained in their Narrative Review on DNS that it focuses on correct patterns of breathing and the correct role of the diaphragm in stabilization, along with the correct activation of the integrated spinal stabilization system initially to any movement at the extremities. It focuses on restoring the ideal movement patterns and neuromuscular control. The author emphasized its use for rehabilitation purposes of various ailments, such as musculoskeletal, neurological, pediatric, as well as sports injuries.

[Alvani E. et al., 2023] In 2023, Alvani determined the impact of DNS exercises on persistent, non-specific low back pain. Another narrative review paper was studied. 35 studies from various search engines, such as PubMed, Google Scholar, Science Direct, and PEDRO, were included by the writers. They differed and varied in their approach, outcome measures, sample numbers, intervention regimens, and evaluation methods. Nonetheless, they all showed that DNS helped those with persistent back pain with their pain and motor function. In the end, the author concluded that DNS exercises are therapeutic and can help patients with non-specific chronic low back pain by improving range of motion, reducing pain and disability, and improving balance and muscle endurance.

[Rabieezadeh A. et al.,2024] The eight weeks of DNS exercise for nonspecific chronic low back pain were analyzed through a randomized clinical trial by the authors. Individuals with non-specific Chronic Low Back Pain (NSCLBP) between the ages of 30 to 50 were selected. The study had a pre-post-test design and included a two-month follow-up. The Visual Analog Scale assessed the intensity of pain, the Oswestry Disability Index assessed functional disability, and finally, the SF-36 questionnaire assessed the quality of life. They ultimately discovered that DNS exercises help people with NSCLBP in their pain, functional disability, and overall quality of life. During the two-month follow-up, they detrained the muscles by not following any exercise regimen and clearly verified the findings, improving the beneficial effects of these exercises.

[Ghavipanje V. et al., 2022] Another RCT investigation by Ghavipanje was done to find the effectiveness of 6 weeks of DNS Training in Obese postpartum women for low back pain (LBP). This was a pre-posttest study design with a sample population of 40 obese post-partum women with LBP. The author provided the following information: height (165.4±6.31) cm, weight (88±6) kg, and age group (29±4), followed by BMI (32.19+1.07) kg/m2. Two groups of sample size were created. While the second group engaged in general exercise six times a week for six weeks, the first group received DNS. The (NPRS) for pain, the Questionnaire (MODQ) for disability, the Questionnaire (FABQ) for psychological evaluation, Inspiration and Expiration Breath Hold Time (BHT), and Respiratory Rate (RR) were the outcome measures. Compared with the general exercise, this study found a significant improvement in the DNS outcome measures. The study proved the DNS's contribution to treating low back pain.

2.6 – **Lumbopelvic Stabilization Exercises and CLPP-**

[De Souza Abreu N et al,2016] The authors conducted a randomized controlled trial and compared the outcome measures of dynamic lumbopelvic stabilization exercises and pelvic floor muscles (PFM) exercise in women suffering from stress urinary incontinence. The pre-post-test design was used, containing; two groups. One of the groups included 17 women who were given the Lumbopelvic Stabilization exercise, while another group of 16 women was made to exercise PFM. The outcome measures were inclusive of the severity of incontinence, QoL, and improvement at 3 moments. Results affirmed, only the climacteric was more common in the lumbopelvic stabilization exercise group (82% versus 44%, P = 0.02) among the sociodemographic and clinical variables at the predetermined level of significance of 5%. Ultimately, the author concluded that the lumbopelvic stabilization exercise and PFM exercises produced patient outcomes that were comparable to those produced by PFM exercises alone. In light of this, it was discovered that the Dynamic lumbopelvic stabilization exercise in conjunction with PFM exercises can result in improved severity of incontinence, QoL, and the perception of betterment in the post-90-day evaluation, all of which have long-lasting effects.

[Paungmali A et al., 2016] According to the authors, lumbopelvic stabilization exercise can help with pain management in chronic, nonspecific low back pain conditions. They examined the effects of Lumbopelvic Stabilization exercises on pain threshold and severity of passive automated cycling intervention and control intervention for persistent nonspecific low back pain (NSLBP). Twenty-five participants—seven men and eighteen women—participated in a crossover RCT of within-subject, repeated measures. Participants were assigned to one of three interventions randomly: lumbopelvic stabilization exercise, passive automated cycling intervention, or the control intervention, with a 48-hour duration pre-post-test design. The hot and cold pain thresholds, pressure pain threshold, and pain intensity were among the outcome measures. All these will be calculated both prior to and following the interventions. According to a repeated-measures ANOVA, lumbopelvic stabilization exercise improved the Pressure Pain Threshold more than the placebo and control treatments did ($P < 0.01$). Compared to both the control and passive automated cycling interventions, the pain intensity was significantly less ($P < 0.001$). Finally, no significant effect on the cold threshold of pain, but the heat

threshold of pain also improved over the control ($P < 0.05$). Lastly, the author concluded that by increasing the pain threshold and decreasing the intensity of pain, lumbopelvic stabilization training has the therapeutic benefit of causing pain modulation. Thus, lumbopelvic stabilization exercise may be included in management plans for the improvement of persistent LBP.

[Shahvarpour A et al.,2017] The authors investigated how effectively an eight-week program of lumbar stabilization exercises shaped both the flexion-relaxation phenomenon and the lumbopelvic rhythm. Low back pain is often linked to these measures. Examining the effects of an 8-week lumbar stabilization protocol on EMG or the kinematics of abnormal patterns of movement in patients with low back pain was the goal of this study. Evaluating the measures' test-retest reliability was the second objective. The control group population received no intervention, while the patient population received an 8-week protocol. The EMG values of paraspinal muscles along with the spine's kinematics during maximal trunk flexion and extension were recorded after the intervention. The impact of the intervention on the patients in comparison to the control was determined by the statistical analysis using ANOVA. In order to determine whether disability and pain had changed after the intervention, the author examined the correlation between the EMG and kinematics measures. The EMG or kinematic determined that there was no change in the outcome measures post-intervention and that the change in lumbar range of motion was positively correlated with the change in disability. They also found a significant reduction in pain, with Hedges' g effect size equal to 2.31 and an improvement in function, with g equal to 1.74. Thus, they ultimately concluded that even though pain and disability have reduced after the intervention, the EMG or kinematics measurements haven't changed in tandem, which may indicate that the patients stiffen their lumbar spines during treatment.

[Dohnert M. B. et al.,2020] Comparing the effect of core stabilization exercises and the McKenzie method on the rehabilitation of patients with lumbar disk protrusion, the authors conducted a blind randomized clinical trial. They grouped the 69 patients of LBP of disc protrusion into three groups: The Core Group (CG), the McKenzie Group (MG), and the Core plus McKenzie Group (CMG). There were 12 sessions of 4 weeks duration, and each group received three interventions per week. The following outcome measures were to be evaluated:

lumbopelvic stability, muscle strength, functional capacity, hamstring flexibility, and pain intensity. The results showed that in addition to improving lumbopelvic stability, quality of life, trunk muscle strength, and posterior muscle chain flexibility, the intervention groups had significantly decreased the pain intensity and functional disability. The SF-26 Questionnaire was utilized to evaluate functional capacity, and posture holding time was measured for the lumbopelvic stability tests. Results were significantly better with the CG and CMG than with the MG ($p < 0.05$). The study concluded that both modalities were effective at decreasing pain and enhancing function. However, when it came to activating the lumbopelvic stabilizing muscles, the stabilization exercise group performed better.

2.7 DNS versus Lumbopelvic Stabilization exercises-

There are many studies indicating the therapeutic effects of DNS and Lumbopelvic Stabilization exercises against low back pain, but very few have studied the effects on dynamic lumbopelvic pain. So far, none have explored the comparative effects of these two techniques on chronic lumbopelvic pain in menopausal women.

Research gaps –

1. Most of the studies conducted so far for pain management address low back pain, and very few have explored the dynamism and multifactorial nature, as well as the needs of chronic lumbopelvic pain.
2. The menopausal stage in a woman's life has its own set of demands and challenges as her body transitions into a new system of depleted protective hormones. Few studies are inclusive of different aspects of menopausal health, and no research has been done on CLPP in menopausal women.
3. DNS is an emerging therapeutic intervention for various musculoskeletal ailments. Research is being conducted in various domains of rehabilitation to explore its effectiveness and dynamism.
4. While various research studies have individually explored the roles of DNS and Lumbopelvic Stabilization exercises in addressing low back pain, none have explored their impact on chronic lumbopelvic pain in menopausal women.
5. There has been no comparative study done so far that involves these two therapeutic approaches to analyze their therapeutic role for long-term benefits against CLPP in menopausal women.
6. Lastly, very few clinical trials have been conducted on this technique to identify its role in various musculoskeletal ailments. There is a clear lack of randomized controlled trials involving these two techniques. Few studies have been conducted on the comparative analysis of the DNS technique with others. Thus, this study will be one of its kind, depicting the comparative role of these techniques for the long-term benefits of menopausal women suffering from CLPP.

Problem Statement-

1. Chronic Lumbopelvic pain (CLPP) has a high prevalence among menopausal women. Still, it is often neglected as a health hazard due to socioeconomic structure, financial burden, and the roles and responsibilities of women.
2. The menopause stage is challenging in terms of health, as depleting estrogen leads to decreased musculoskeletal health, including lower muscle strength and bone health, along with psychosomatic changes that affect mental health. These hormonal
3. Changes often predispose a woman to gain weight, which brings another challenge as it burdens the lumbopelvic musculature by altering the biomechanics.
4. Despite the availability of many conventional physiotherapy treatments, there is a lack of long-term treatment strategies for Lumbopelvic pain that can address the multifactorial nature of the problem and act dynamically to address these multidimensional aspects of treatment.

Also, we need a CLPP management strategy that can be incorporated into the daily routine of a woman without laying any financial burden, and adopted easily.

5. **Description of the Broad area –**

   The health of women is a less addressed topic in research studies, especially menopausal health. The menopausal population is often understudied, often due to the non-addressing of health problems by menopausal women due to various constraints of socioeconomic constraints or awareness level. The weight gained during multiple pregnancies and the stress imposed on the lumbopelvic musculature during the reproductive years often predispose a woman to the development of chronic lumbopelvic pain later in life, as the weight gained alters the biomechanics of the musculoskeletal system and stresses the lumbopelvic region. Also, due to hormonal depletion, the pain perception changes in menopausal women, so it can add to disability and affect the QOL. Both these techniques, DNS and Lumbopelvic Stabilization exercises, have the potential to address the multifactorial demands of menopausal women to alleviate the effects of CLPP.

This study will explore the dynamism of these two techniques on CLPP management in menopausal women. Also, it will guide us to an effective treatment strategy, which will be comparatively better to address the needs of the postmenopausal population.

3.5 **Research Question**

1. Which of the two techniques has a better prognosis in treating the CLPP?
2. Which of the two techniques produces better muscle health?
3. Which of the two techniques provides better QOL in the post-menopause stage?
4. Which of the two techniques provides more flexibility?
5. Which of the two techniques provides better psychological well-being or mental health?

Significance of the study-

1) This study will provide an effective chronic lumbopelvic pain management strategy that has the potential to address the multifactorial demands of menopausal women.
2) This study will explore the effect of dynamic neuromuscular stabilization(DNS) versus Lumbopelvic stabilization exercises for the management of chronic lumbopelvic pain, Disability, Muscle strength, Psychological well-being, Flexibility, menopausal health, and quality of life.
3) This study will compare the DNS and Lumbopelvic Stabilization Exercise techniques and will find a better management strategy for Chronic lumbopelvic pain in menopausal women.

Objectives of Research – Primary Objective-

1) To evaluate the individual effect of Dynamic Neuromuscular Stabilization (DNS) and Lumbopelvic Stabilization Exercises as a treatment strategy for Chronic Lumbopelvic Pain and Pelvic asymmetry in obese post-menopausal women.
2) To evaluate the individual effectiveness of the DNS and Lumbopelvic Stabilization exercises on the abdominal muscle strength, level of disability,

menopausal health, mental health, and quality of life in obese postmenopausal women.

Secondary Objective-

1) To compare the effectiveness of the DNS and the Lumbopelvic Stabilization exercise protocol for the management of Chronic Lumbopelvic pain and pelvic asymmetry.
2) To compare the effect of the DNS and the Lumbopelvic Stabilization exercise protocol on the abdominal muscle strength, level of disability, menopausal health, mental health, and Quality of life in obese postmenopausal women.
3) To find a better intervention for the alleviation of Chronic Lumbopelvic pain in Obese post-menopausal women.

Research Methodology

Research Methodology –

5.2 Study type – Experimental study with 3 groups.

5.2 Sample Size – The sample size is evaluated by G-Power (version 3.1.9.7). A priori power analysis for a repeated-measures ANOVA (analysis of variance) examined within-between interaction and 2 repeated measures showed a required sample size of n = 72, considering the 20% dropout rate for three groups.

5.3 Study design - Randomized Controlled Trial (RCT) will use a pre-post-test design.

5.4 Inclusion Criteria –

1. Women in the age group above 40 years to 55 years who are postmenopausal. (Stages of Reproductive Aging Workshop criteria).
2. Multiparous women with cessation of menses for at least a year or more.
3. BMI – more than 23 (classified as overweight/obese). (As per Asian Indian BMI criteria)
4. Chronic Lumbopelvic pain for more than 12 weeks. [Sushil P, Chawla JK, Parashar R, et al., 2023] (CLPP Prediction Model)
5. Participants who are willing to finish the intervention protocol period.
6. Prediction diagnostic value depicting ≥ 50% will be included in the study - CLPP Prediction Model (Chawla JK et al. 2024)
7. Participants who fulfill the criteria as per the inclusion proforma (Appendix) and have the diagnostic feature of major risk factors associated with lumbopelvic pain as per the latest research findings by [Chawla J.K. et al.,2023]

a- The hamstring muscle tightness will be measured by the passive knee extension test.
b- The increased lumbar lordotic index.
c- The decreased flexibility in the hips will be assessed by the bent-knee fallout test
d- Enhanced psychological stress perception will be assessed by Cohen's perceived stress scale.
e- Decreased physical activity level assessed by the International Physical Activity Questionnaire.

f- Altered foot posture will be assessed by the foot posture index score.

g- Diminished transversus abdominis muscle performance measured by the deep muscle contraction scale.

5.5 Exclusion Criteria

1. History of any recent trauma or any surgery, mainly fractures, abdominal surgery, or hysterectomy.
2. Any spinal injury or deformity, e.g., prolapsed disc, scoliosis
3. Any radiculopathy or inflammatory pathology of the spine.
4. Neurological or systemic conditions (e.g., rheumatoid arthritis, fibromyalgia).
5. Any other study participation in exercise programs.
6. Receiving any therapy such as Hormone Therapy, psychotropic medications, or sleeping pills.

5.6 Variables

A. Dependent Variables

1. Muscle Strength (Pressure Biofeedback)
2. Numeric Pain Rating Scale (NPRS)
3. Pelvic Asymmetry (Pelvic inclinometer)
4. The Oswestry Disability Index (ODI). (questionnaire)
5. The Fear-Avoidance Beliefs Questionnaire (FABQ). (questionnaire)
6. MENQOL (questionnaire)

B. Independent Variables

1. Lumbopelvic Stabilization Exercise
2. DNS exercise protocol

5.7 Procedure—The sample population will be recruited from various orthopedic, gynecologic, and physiotherapy clinics across the Aligarh district with complaints about CLPP. The sample will be chosen and split into three equal groups according to the inclusion criteria: A control group and two experimental groups. Simple random sampling will be used to assign the individuals to the three groups. After being briefed in detail on the purpose and methodology of the study, the patient will give informed consent in English or Hindi for participation. Also, the patients will be informed that their information is for research purposes only and will be kept confidential. They will be informed about their right to withdraw.

5.8 Research Protocol

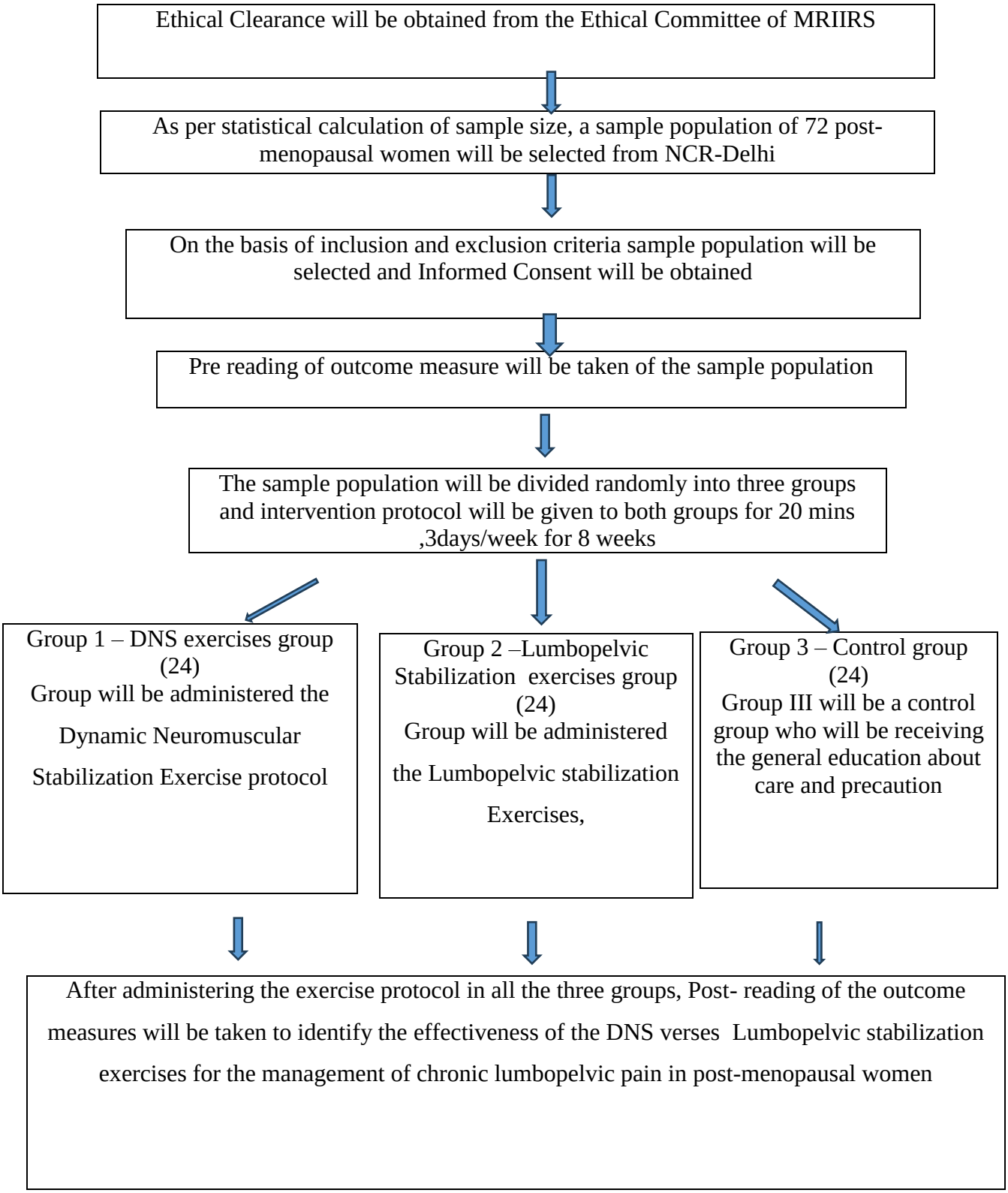
Based on the inclusion criteria, the selected sample population will be recruited, and informed consent will be obtained. The proforma will be completed, and all demographic information will be requested. Each patient will undergo a thorough physical examination and medical screening. BMI, menopausal health, and outcome measures such as pain (NPRS), disability (Oswestry disability questionnaire), pelvic asymmetry (pelvic inclinometer), muscle strength (transverse abdominis using pressure biofeedback), menopausal health and quality of life (MENQOL), and mental health (psychological well-being -FABQ) will be the baseline measurements. They will be split up into three groups of twenty-four people at random. Group 1 will be given the DNS exercise intervention, Group 2 will be given the Lumbopelvic stabilization exercise intervention protocol, and Group 3 will be the control group, which will be provided with the general information for prevention and care. Post-reading will be taken after 8 weeks for 3 3-day/week sessions of a 20-minute intervention protocol.

Interventions –

1-DNS exercise protocol

2- Lumbopelvic Stabilization Exercise Protocol

RESEARCH PROTOCOL


Ethical Clearance will be obtained from the Ethical Committee of MRIIRS
As per statistical calculation of sample size, a sample population of 72 post-menopausal women will be selected from NCR-Delhi
On the basis of inclusion and exclusion criteria sample population will be selected and Informed Consent will be obtained
Pre reading of outcome measure will be taken of the sample population
The sample population will be divided randomly into three groups and intervention protocol will be given to both groups for 20 mins ,3days/week for 8 weeks
Group 1 – DNS exercises group (24)
Group will be administered the Dynamic Neuromuscular Stabilization Exercise protocol
Group 2 –Lumbopelvic Stabilization exercises group (24)
Group will be administered the Lumbopelvic stabilization Exercises,
Group 3 – Control group (24)
Group III will be a control group who will be receiving the general education about care and precaution
After administering the exercise protocol in all the three groups, Post- reading of the outcome measures will be taken to identify the effectiveness of the DNS verses Lumbopelvic stabilization exercises for the management of chronic lumbopelvic pain in post-menopausal women

DNS EXERCISE PROTOCOL FOR LUMBOPELVIC PAIN IN OBESE MENOPAUSAL WOMEN

General Guidelines

- **Duration**: 8 weeks.
- **Frequency**: 3 sessions per week.
- **Dosimetry**:
    - 3 sets of 10 repetitions.
    - Hold each contraction for 8–10 seconds.
    - Rest 10 seconds between contractions.
    - Rest 1–2 minutes between sets.

Phases of the DNS Protocol

Phase 1 (Weeks 1–2): Foundational Stabilization and Breathing Retraining

Focus: Diaphragmatic breathing and basic core stability in static positions.

1. **Supine 3-Month-Old Position**
    - **Position**: Supine with knees bent and feet flat. Arms rest at chest level, mimicking the 3-month-old developmental posture.
    - **Instructions**:
        - Inhale deeply into the lower ribs, expanding them laterally.
        - Exhale, activating the TrA and pelvic floor without moving the spine.
        - Keep the head, neck, and pelvis in neutral alignment.
    - **Reps**: 3 sets of 8–10 breaths.
2. **Diaphragmatic Breathing with Abdominal Wall Activation**
    - **Position**: Supine with knees bent, hands placed on the lower ribs.
    - **Instructions**:
        - Focus on lateral expansion of the lower ribs during inhalation.
        - Exhale slowly, gently engaging the pelvic floor and TrA without increasing intra-abdominal pressure (IAP).

- **Reps**: 3 sets of 10 breaths.

3. **Side-Lying Position with Ribcage Expansion**
    - **Position**: Side-lying with hips and knees slightly bent.
    - **Instructions**:
        - Inhale deeply, feeling the ribcage expand laterally.
        - Exhale and engage the pelvic floor and TrA, maintaining alignment.
    - **Reps**: 3 sets of 8–10 breaths.

Phase 2 (Weeks 3–4): Core Activation and Dynamic Stabilization

Focus: Enhance core stability and motor control in functional postures.

1. **Quadruped Position with Diaphragmatic Breathing**
    - **Position**: Hands below the shoulders, knees below the hips, maintaining neutral spine.
    - **Instructions**:
        - Inhale deeply, expanding the lower ribs.
        - Exhale, activating the pelvic floor and TrA while avoiding excessive IAP.
    - **Reps**: 3 sets of 8–10 breaths.
2. **Quadruped Rocking**
    - **Position**: Same as above.
    - **Instructions**:
        - Inhale deeply.
        - Exhale and gently rock backward toward the heels while maintaining core engagement.
        - Return to the starting position without losing alignment.
    - **Reps**: 10 repetitions per set.
3. **Wall-Supported Squat with DNS Breathing**
    - **Position**: Back against the wall, feet hip-width apart.
    - **Instructions**:
        - Inhale, expanding the ribcage laterally.

        - Exhale, engaging the pelvic floor and TrA, and descend into a partial squat.
        - Maintain alignment and avoid excessive IAP.
    - **Reps**: 3 sets of 10 squats.

Phase 3 (Weeks 5–6): Advanced Stability and Functional Movements

Focus: Improve dynamic stability in functional and transitional movements.

1. **Modified Bear Position (Kneeling on All Fours)**
    - **Position**: Kneeling on all fours, lifting the knees slightly off the ground.
    - **Instructions**:
        - Inhale deeply, maintaining spinal alignment.
        - Exhale, engaging the pelvic floor and TrA while holding the position.
    - **Hold**: 8–10 seconds.
    - **Reps**: 3 sets of 10 holds.
2. **Rolling Pattern Activation**
    - **Position**: Supine, arms overhead.
    - **Instructions**:
        - Engage the core to roll to one side without using the legs or momentum.
        - Maintain diaphragmatic breathing throughout the movement.
    - **Reps**: 5 rolls per side per set.
3. **Bird Dog with DNS Breathing**
    - **Position**: Quadruped, hands under shoulders, knees under hips.
    - **Instructions**:
        - Extend alternate arm and leg, keeping neutral spine.
        - Exhale, engaging the pelvic floor and TrA, and hold for 8–10 seconds.
    - **Reps**: 3 sets of 10 repetitions per side.

Phase 4 (Weeks 7–8): Functional Integration and Stability in Dynamic Tasks

Focus: Integrate core stability into advanced functional movements.

1. **Dead Bug in DNS 3-Month-Old Position**
    - **Position**: Supine, arms and legs raised to 90°.
    - **Instructions**:
        - Inhale, maintaining ribcage and pelvic alignment.
        - Exhale, lowering one arm and the opposite leg while engaging the pelvic floor and TrA.
    - **Reps**: 10 repetitions per side per set.
2. **Lunge with DNS Core Engagement**
    - **Position**: Standing, feet hip-width apart.
    - **Instructions**:
        - Step forward into a lunge while maintaining core engagement and a neutral spine.
        - Inhale during the descent, exhale to engage the pelvic floor and TrA while returning to standing.
    - **Reps**: 10 repetitions per side per set.
3. **DNS Plank with Shoulder Taps**
    - **Position**: Forearm plank position.
    - **Instructions**:
        - Exhale and engage the core, and with it you lift one hand and tap the opposite shoulder.
        - On Alternate sides, maintain spinal alignment.
    - **Reps**: 8–10 taps per side per

Lumbopelvic Stabilization Exercise Protocol For Lumbopelvic Pain in Obese Post-Menopausal Women-

General Guidelines

- **Duration**: 8 weeks.
- **Frequency**: 3 sessions per week for 20 min.

Phase 1- (week 1-2) To activate the muscles and achieve stability

Goal- To achieve muscle activation, neuromuscular control and pain reduction.

1. **Abdominal hollowing- (Drawing-in Maneuver)**

Position: Maintain a supine position with feet flat on floor and knees bent, about hip-width apart. The spine will be in a neutral position, and the arms will be at ease on their sides.

Instructions:

- Inhale through your nose and expand your belly.
- Exhale from your mouth and pull your belly button towards your spine.
- Keep the pelvis, ribs, and spine stable i.e., without any movement.

Reps: 2-3 sets -10 reps, 5-10 sec rest.

2. **Alternate Leg Raise with core stabilization. (Marching)**

Position: Maintain a supine position with feet flat on the floor and knees bent, about hip-width apart. The spine will be in a neutral position, and the arms will be at ease on their sides.

Instructions:

- Inhale with your nose and exhale with your mouth, and then pull your belly button towards your spine (i.e. keep the transverse abdominis activated)
- Keep breathing normally by keeping your pelvis and low back stable, and start lifting your right leg so that your hip and knee both bend to about 90 degrees.
- Keeping the abdominal contraction constant, lower the right leg and keep the foot back on the floor.
- Repeat the same with the left side. That will complete one cycle.

Reps: 2-3 sets - 10 reps, 30 sec rest in between.

3. **Isometric Gluteal Squeezes-**

Position: Supine with bent knees and flat feet on the floor, keeping feet hip-width apart. The arms will be relaxed on the sides, and the spine will be in neutral, with neck and shoulders relaxed.

Instructions:

- Lying position squeezes both buttocks together as if trying to pinch a coin between both cheeks.
- Contract your glutes only with moderate intensity and normal breathing.
- Slowly release and fully relax the muscles. Repeat the same for prescribed repetitions.

Reps: 2-3 sets - 10-15 reps, 5 sec hold and 10 sec rest in between the contractions.

4. **Clamshell-**

Position: Side lying with the hips and knees bent to about 45 degrees and ankles stacked on each other. The head will be supported by lower arm or a pillow, with the spine will be in neutral.

Instructions:

- Inhale with your nose and exhale with your mouth, and then pull your belly button towards your back (i.e., keep the transverse abdominis activated) or perform the abdominal hollowing.
- Maintaining the foot touch, lift your top knee upwards by opening the knees like a clamshell opening by keeping your pelvis and spine stable.
- Lift only up to the position where you can maintain stability.
- Then slowly lower the knee to the initial position.

Reps: 2-3 sets, 10-15 reps, and 10 sec rest in between the contractions.

Phase 2- (week 3-5)- To achieve stability and endurance

Goal- To improve the dynamic control and to engage the stabilizers while movement.

1. **Clamshell progression-**
    - **Position:** Side lying with the hips and knees bent to about 45 degrees and ankles stacked on each other. The head will be supported by the lower arm or a pillow, with the spine in neutral.

Instructions:

- Inhale with your nose and exhale with your mouth, and then pull your belly button towards your spine (i.e., keep the transverse abdominis activated) or perform the abdominal hollowing.
- Maintaining the foot touch, lift your top knee upwards by opening the knees like a clamshell opening by keeping your pelvis and spine stable.
- Lift only up to the position where you can maintain stability.
- Do a brief hold of 5-10 sec, slowly lower the knee back to the initial position.

Reps: 2-3 sets - 10-15 reps with 5-10 sec hold and 30 sec rest in between the contractions.

2. **Gluteal Bridge progression-**

Position: Maintain a supine position with your feet flat on the floor and your knees bent. The arms at the sides and the spine is in neutral with neck and shoulders relaxed.

Instructions:

- Lie on your back and lift your hips and squeeze the glutes until your body forms a straight line.
- Maintain the contraction of the glutes and hold for 5-10 seconds while lifting your hips.
- Slowly release and lower the hips. Repeat the same for prescribed repetitions.

Reps: 2-3 sets- 10-15 reps with 5-10 seconds hold and 30 seconds rest in between the contractions

3- **Pelvic tilts- (antero-posterior)**

Position: The arms will be relaxed on the sides, and the spine will be in neutral, having the natural curve under the lower back, with neck and shoulders relaxed.

Instructions:

- Lie on your back and contract your abdominals, especially lower abs.
- Then tilt your pelvis backward slowly as if you are trying to press your lower back flat into the floor.
- Assume the pubic bone pulling and coming towards your rib cage.
- You can feel buttocks and abdominals working together.
- Release the contraction slowly and bring the spine to the starting neutral position.
- Repeat the same process.

Reps: 2-3 sets, 10-15 reps, 5-10 seconds hold, and 30 seconds rest in between the contractions.

4- Wall-supported Mini squats-

Position- Standing with back against the wall by keeping the feet about hip-width apart and about 12-18 inches (i.e., about 30-45 cm) away from the wall. Keep the arms lightly against the wall for balance with the head, upper back, and pelvis touching the wall (neutral posture)

Instructions:

- Stand against the wall with your back supported.
- Now contract your abdominals and slowly bend your knees for a short distance down the wall (30-45 degrees of knee flexion).
- Assume as if you are going to sit back into a chair by keeping your back lightly against the wall.
- Your feet should stay on the ground.
- Slowly return to the original standing position and repeat.

Reps: 2-3 sets, 10 reps,30 sec rest in between.

5- Modified Dead Bug (with single limb):

Position: Supine lying with the hips and knees flexed to 90 degrees and feet stable. The arms can be placed on the sides of the chest or the stomach to feel the contraction. The spine will be in neutral without any arching, with neck and shoulders relaxed.

Instructions:

- Lie on your back and bend your hips and knees, then keep your arms on your abdominals.
- Contract or tighten your abdominals and lower down one leg slowly towards the floor so that you can tap your heel to the floor while keeping the other leg stable.
- Repeat the same with the other leg from the initial position.

Reps: 2-3 sets of 10 reps with 2-3 seconds tap at floor (brief hold) and 30 sec rest in between the contractions.

Phase 3- (week 6-8)- To bring the dynamic control with strengthening and Functional movements.

Goal- To strengthen the core and functional movements with coordination.

1. **Dead Bug (with alternate limbs):**

Position: Supine lying, keeping hips and knees flexed to 90 degrees and feet stable. The arms extended straight toward the ceiling in the initial position. The spine will be in neutral without any arching, with neck and shoulders relaxed.

Instructions:

- Lie back, bend your hips and knees, and raise your arms towards the ceiling.
- Contact or tighten your abdominals and lower down opposite and alternate limbs simultaneously and slowly towards the floor so that you can tap your heel to the floor while keeping the other leg stable, but do not touch the floor, and similarly do not touch floor with the arm.
- Bring the moving leg to the position as far as which you can control and keep your lower back stable on the floor (i.e., without arching).
- Now, slowly bring both limbs to the original initial position and Repeat with the other pair of opposite and alternate limbs. left arm and right leg)

Reps: 2-3 sets, 10 reps, 2-3 seconds in the extended position and 45-60 sec rest in between the contractions.

2. **Side-lying hip abduction (Clamshell progression)-**

Position: Side lying with the hips in vertical alignment over each other and the bottom knee bent slightly for achieving stability, while the leg will be kept straight in alignment with the spine. The head will be supported by the lower arm or a pillow and the shoulders relaxed.

Instructions:

- Inhale from the nose and exhale from the mouth, and then pull your belly button towards your spine (i.e., keep the transverse abdominis contracted) or perform the abdominal hollowing.
- While keeping the top leg straight, lift your top leg upwards by 30-45 degrees and move straight up by keeping the pelvis and spine stable.
- Lift only up to a comfortable position where you can maintain stability.
- Brief hold of 2-3 seconds, then bring the leg back to start.
- Repeat the reps on one side, then follow with the other side.

Reps: 10-15 reps, 2-3 sets, 2-3 seconds hold with 30 sec rest.

3. **Bridging Progression - Single-leg Bridge (Gluteal bridge progression)**

Position: Maintain a supine position with flat feet and bent knees, about hip-width apart. The arms will be relaxed on the sides with palms facing downwards for support, and the spine will be in neutral with neck and shoulders relaxed.

Instructions:

- Lie back, lift the hips, and squeeze the glutes while your body forms a straight line.
- Now shift the body weight on one leg and lift the other leg off the floor, and bend it to 90 degrees.
- Maintain the contraction of the glutes while keeping the pelvis stable and hold for 2-3 seconds while lifting single leg.
- Slowly release and lower the raised leg in a controlled manner along with the hips/pelvis, back to the floor.
- Repeat the same for sequence for the other leg for prescribed repetitions.

Reps: 2-3 sets of 10 reps with 2-3 seconds hold and 45-60 sec rest in between the contractions.

4. **Side plank with knees supported**

Position: Side lying with elbow (right side lying and right arm)directly under the shoulder and forearm resting forward for support. The knees will be bent to 90 degrees while hips and shoulders will be stacked vertically with the upper arm resting alongside or on the hip.

Instructions:

- Contract the abdominals and squeeze the buttocks.
- Lift your hips and press down on your elbow and bent knees on the floor until your body forms a straight line from knees to shoulders.
- Balance the position on lower knee and forearm only by keeping the spine neutral.
- Return to the original resting position in a controlled manner.
- Finish the required reps on each side .

Reps: 2-3 sets of 2-3 reps on each side with 5-10 seconds hold and 45 sec rest in between the contractions.

5. **Bird Dog- (Quadruped Arm and leg reach)**

Position: Quadruped position with hands and knees supported on the firm mat. Keep hands directly under the shoulders and knees under hips about hip width apart. Keep the neck in neutral and contract the abdominals.

Instructions:

- Achieve the stable position of being on all fours and contract your abdominals by keeping the spine stable.
- Now extend your right arm forward and left leg backwards slowly at the same time, simultaneously, as if you are trying to touch the opposite walls.
- The extended arm and leg should be parallel to the floor by keeping the pelvis stable.
- Return to the original position by slowly bringing the arm and leg back to the starting position by maintaining stability without shifting the body.
- Repeat the same for the opposite side with alternate limbs (left arm and right leg).

Reps: 2-3 sets of 5-10 reps with 2-3 seconds hold and 45-60 sec rest in between the contractions.

6 c - Outcome Measures

- Muscle Strength (Transversus Abdominis): Pressure Biofeedback
- Pain Intensity: Numeric Pain Rating Scale (NPRS).
- Pelvic Asymmetry: Pelvic Inclinometer
- Psychological well-being Measures: Fear-Avoidance Beliefs Questionnaire (FABQ).
- Menopausal health – by MENQOL Questionnaire
- Functional Disability: by Oswestry Disability Index (ODI) Questionnaire

6 d- Operational definitions-

Pressure Biofeedback assesses the activation of the Transverse Abdominis (TrA) muscle by measuring the pressure changes produced in the pressure biofeedback unit. It assesses the pressure changes using the pressure sensors.

Method of Assessment -

- The patient will be asked to lie supine (face-up) with knees bent (hook-lying position) and feet flat on the surface by keeping the pressure biofeedback unit (PBU) under the lumbar area at the L4-L5 level.
- Ask the patient to relax and we will inflate the PBU to 40 mmHg while keeping the neutral spinal alignment..
- Then, the patient will be asked to pull the lower abdomen inward toward the spine without excessive movement of the pelvis or ribcage (i.e., abdominal draw-in maneuver also called "hollowing" or "core activation").
- We measure the pressure changes to assess the muscle strength. The Transverse Abdominis (TrA) activation will cause a slight reduction in pressure (~4-10 mmHg) from the baseline.

Pelvic Inclinometer-

We will assess the pelvic asymmetry through a Pelvic inclinometer. This device measures the pelvic tilt in different planes to assess posture, musculoskeletal alignment, and functional

movement. We will measure the pelvis's anterior tilt, posterior tilt, and lateral tilt**,** which is important for evaluating lower back pain, postural imbalances, and rehabilitation progress**.**

Method- We ask the patient to stand in a relaxed, upright posture with feet shoulder-width apart on a firm, flat surface by keeping the neutral spine to avoid compensatory movements. We will palpate the Anterior Superior Iliac Spine (ASIS) and Posterior Superior Iliac Spine (PSIS). We place the inclinometer at these points to measure the angle difference for anteroposterior pelvic tilt. For lateral pelvic tilt, the inclinometer ends are kept at the iliac crests. We will compare the left and right sides to check for asymmetry.

- If one iliac crest is higher than the other, it indicates an asymmetrical pelvic alignment.
- The pelvis is tilted forward, indicated by a lower ASIS than PSIS
- The pelvis is tilted backward, indicated by higher ASIS than PSIS.

Oswestry Disability Index (ODI) Questionnaire:

It measures functional disability related to low back pain. It is a widely used, self-administered questionnaire that is designed to assess the degree of disability and functional impairment in individuals experiencing low back pain.

Psychological Well-being: Fear Avoidance Beliefs Questionnaire (FABQ)

It refers to an individual's overall mental state, characterized by the presence of positive emotions, life satisfaction, and a sense of purpose or meaning. This study will measure these parameters through a self-reported questionnaire, named FABQ (Fear-Avoidance Beliefs Questionnaire of 16 items in total, with 2 subscale items. It assesses how a patient's fear of pain and movement contributes to their avoidance behaviors.

The Low scores will indicate minimal fear-avoidance beliefs.

The Moderate scores will indicate there is potential influence on the pain-related behavior

The higher score is indicative of that individual will likely avoid activity/work due to fear of pain (≥15 PA or ≥34 W)

MENQOL:

The **Menopause-Specific Quality of Life (MENQOL) Questionnaire** is a standard questionnaire. It indicates the impact of menopausal symptoms on women's quality of life.

Prediction Model of risk factors for Lumbopelvic pain:

The inclusion criteria of the sample population for this study, and also the differential diagnostic criteria for lumbopelvic pain from low back pain, are the seven major risk factors as stated by [Chawla J.K. et al,2024]. For an individual to be classified as having Lumbopelvic Pain, the major risk factors associated with it are assessed by

I. Hamstring muscle tightness by the passive knee extension test-

Using a universal goniometer, the passive knee extension angle (PKEA) will be used to measure the hamstring muscles' flexibility. Shorter hamstring muscles will be indicated by a PKEA of >20 degrees.

II. Increased lumbar lordosis by the lumbar lordotic index-

Lumbar and Thoracic region spinal curves will be traced on a graph sheet with the flexicurve ruler. Thoracic kyphosis and lumbar lordosis will be calculated with a trigonometric formula in degrees. Then, the Lumbar lordotic index (LI) as well as the Thoracic kyphotic index (KI) will also be calculated in cms. (Greendale G.A. et al.,2011, de Oliveira T.S.et al.,2012, Hart D.L. et al,1986).

III. Reduced hip flexibility by the bent knee fallout test-

The bent knee fallout test (BKFT) evaluates the ROM of the hip joint. It involves a combination of movements at the hip and knee joint, including flexion, abduction, and external rotation. We will measure the distance (in centimeters) between the head of the femur and the treatment plinth. One of the main risk factors for LPP is decreased hip flexibility, which is indicated by a BKFT value of more than 15 cm.

IV. Altered foot posture by foot posture index score-

The foot posture index (FPI-6) evaluates the participants' foot posture. It includes the following steps: 1. talar head palpation; 2. curves above and below the lateral malleolus; 3. prominence in the talonavicular joint region; 4. calcaneal frontal plane position; 5. abduction/adduction of the forefoot on the rear foot; and 6. height and congruence of the medial longitudinal arch. Pronated foot posture is indicated by positive FPI-6 scores, whereas supinated foot posture is indicated by negative scores (Keenan A. M. et al., 2007).

Total Score Obtained for the Foot Posture-

- -12 to -5 -Highly supinated
- -4 to -1 -Supinated
- 0 to +5 -Neutral
- +6 to +9 -Pronated
- +10 to +12 -Highly pronated

V. Enhanced psychological stress measured by Cohen's perceived stress scale-

The perception of general psychological stress will be measured by Cohen's perceived stress scale (PSS-10). It asks ten questions about thoughts and feelings over the past month. On a Likert scale of 5-point, each item will receive a score. A greater sense of stress is indicated by PSS-10 scores greater than 25 [Cohen S., 1983].

VI. Reduced physical activity level by the International Physical Activity Questionnaire (IPAQ)-

With the Questionnaire (IPAQ), the study participants' level of physical activity will be assessed and scored in metabolic equivalents/minutes (MET/minute) [Guthold R., 2008]. A score below 475 MET/Minute indicates a decrease in physical activity.

VII. The transversus abdominis muscle performance is measured by the deep muscle contraction scale score-

Based on the results of the deep muscle contraction scale (DMC), the transversus abdominis (TrA) performance will be graded. Participants will perform an abdominal draw-in maneuver (ADIM) while lying crookedly. A quality, symmetry, and substitution score will be assigned to the palpated TrA contraction (Oliveira C.B. et al, 2017).

Proposed/expected outcome of the research –

The study will find an effective treatment intervention for the treatment of CLPP, which can be applied for long-term health benefits by postmenopausal women. This intervention exercise can be easily incorporated into the everyday lives of women as it is cost-effective. It does not require any appliance or specific location for practice, and it does not have any side effects that can be deleterious to any woman. Once proven, beneficial effects can be practiced on an everyday basis about individual needs.

We expect to find an effective treatment intervention that can be applied to the unique and multifactorial needs of perimenopausal women for the treatment of CLPP that can be incorporated into their daily lives for an improved quality of life.

6 e - Experimental Hypothesis:

- There will be a significant effect of Dynamic Neuromuscular Stabilization(DNS) exercises in improving pain, muscle strength, pelvic alignment, disability, mental health, and menopausal QoL in postmenopausal women.
- There will be a significant effect of Lumbopelvic Stabilization exercises in improving pain, muscle strength, pelvic alignment, disability, mental health, and menopausal QoL in postmenopausal women.
- There will be a significant difference in the effectiveness of Dynamic Neuromuscular Stabilization(DNS) versus Lumbopelvic Stabilization exercises in improving pain,

muscle strength, pelvic alignment, disability, mental health, and the menopausal quality of life in postmenopausal women.

Null hypothesis:

- There will be no significant effect of Dynamic Neuromuscular Stabilization(DNS) exercises in improving pain, muscle strength, pelvic alignment, disability, mental health, and menopausal quality of life in postmenopausal women.
- There will be no significant effect of Lumbopelvic Stabilization exercises in improving pain, muscle strength, pelvic alignment, disability, mental health, and menopausal quality of life in postmenopausal women.
- There will be no significant difference in the effectiveness of Dynamic Neuromuscular Stabilization(DNS) and Lumbopelvic Stabilization exercises in improving pain, muscle strength, pelvic alignment, disability, mental health, and menopausal quality of life in postmenopausal women.

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